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Red Pine Pocket Decline

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Background and Objectives

Red pine pocket decline was first reported in Wisconsin in 1975. Initially almost unknown to most foresters, in the past five years we have seen a dramatic increase in the number of pockets reported in certain parts of the state. Red pine pocket decline is actually a disease complex involving several species of root and lower stem-feeding insects along with their fungal symbionts. They initiate a sequence of events that create circumscribed areas or “pockets” of progressive mortality of one to several trees (Figure 1). Once introduced, fungal hyphae spread through the extensively grafted root system of red pine stands continually stressing new trees. These otherwise healthy pines then become attractive to beetle attack, creating an expanding border of dead trees. Unless root grafts are severed, harvesting symptomatic trees will not halt the spread of the fungus to healthy trees.



Figure 1. A typical pocket has trees in several stages of mortality indicating the progressive nature of the disease.

In 2001, members of the Dept of Natural Resources Silvicultural Committee in cooperation with the staff of Forest Health Protection initiated a multi-year study of red pine pocket decline. The objectives were 1) to determine geographic differences in disease incidence and severity, 2) to investigate site or stand characteristics or past management practices which might be correlated with disease incidence, and 3) to develop from this analysis, silvicultural guidelines which would help prevent pocket formation and/or limit expansion of already established pockets.

The study was divided into 2 stages. The first involved an extensive survey of randomly selected 30-40 year old red pine stands to determine geographic distribution of the disease and to identify site or stand characteristics correlated with incidence. The second stage would involve an intensive study of selected stands to further delineate the role of factors identified in stage one.

Discussion

The incidence of red pine pocket decline observed in this study was fairly high. Figure 2 shows the location of surveyed stands and the number of pockets per stand. Over two-thirds (109) of 157 surveyed stands had at least 1 pocket. However, the number of pockets per stand was small in most cases and most pockets had few symptomatic trees, over one-third having fewer than 6. On the other hand, there were several stands with a large number of pockets, over 1 pocket for every 2 acres surveyed and where pockets were fairly large, averaging between 1 and 2 percent of all red pine in these stands. This wide variation suggests either that pocket decline is worse on some sites and self-limiting on others or that it is just beginning to show up in many red pine stands throughout the state and that these small pockets may expand rapidly in the near future.

With respect to geographic distribution, there does seem to be an important difference in disease incidence and severity between northern and southern Wisconsin. The number of pockets, as well

as the average and maximum size of pockets per stand is lower in northern Wisconsin. Pocket size also seems to be more dependent on site quality in the north. For instance, mesic sites have significantly lower levels of disease than very dry sites in northern Wisconsin whereas, in the south, there's no difference between dry and mesic habitat types.

There are several possible reasons for this difference. In southern Wisconsin, red pine is on the lower edge of its range (Burns and Honkala, 1990) and may be more susceptible to temperature variations. There is evidence that temperatures, specifically average winter minimum temperatures have risen substantially in Wisconsin in the last 10 years (Wisconsin State Climatology Office). This may contribute both to higher levels of stress on red pine and to increased winter survival or activity of insects like the red turpentine beetle.

Site quality in general did not seem to be strongly correlated with disease incidence. Habitat type was only significant in northern Wisconsin where an increase in the incidence of disease was observed on very dry sites. Other site factors, however, may affect where pockets are initiated. For instance, it was frequently observed that new pockets were located adjacent to forest roads, low-lying areas or wetlands. Along roads this may be due to root and stem damage caused by logging machinery and in wet areas, damage to red pine root systems caused by water-logged soils. For older pockets, it was usually too difficult to determine pocket origin.

A very important finding of this survey was the co-occurrence of red turpentine beetle (*Dendroctonus valens*) and *Leptographium spp.* in the vast majority of pockets. For instance, *Leptographium* was recovered in wood samples from 95% of stands, 91% of all pockets and most importantly, 96% of pockets with evidence of *D. valens*. Of the two species of *Leptographium*, *L. terebrantis* and *L. procerum* (Klepzig et al, 1991) which are consistently isolated from symptomatic pockets, *L. terebrantis* is much more commonly associated with red turpentine beetle (*D. valens*). This lower stem-feeding bark is primarily recovered from beyond the pocket margin whereas the root-feeding insects are more abundant within pockets.

These facts suggest that *D. valens* and *L. terebrantis* may play an aggressive role in pocket expansion and possibly in pocket initiation. A primary feeding site for these beetles is freshly cut stumps as well as healthy trees nearby. We noticed in this survey that pockets were almost nonexistent in unthinned stands, i.e. where no stumps were present. We also observed very high numbers of *D. valens* in very recently thinned stands surveyed during the period of beetle flight in late spring. These observations point to the possible role of thinning and specifically the time of year in which a stand is thinned in pocket formation..

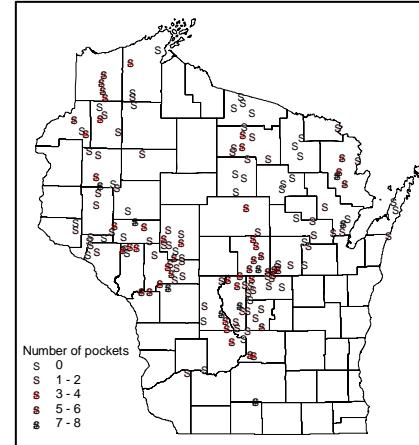


Figure 2. There were 344 pockets in the 157 sampled stands

Areas of Future Investigation

Several questions were raised by the results of the first stage of this study that we would like to address in the intensive phase. These include: 1) does the rate of pocket expansion vary on different sites or in different parts of the state 2) does the time of year when a stand is thinned affect vector populations and the probability of pocket initiation, and 3) can we more accurately assess the species of *Leptographium* which play a role in pocket initiation and/or expansion with the use of DNA analysis? We will continue research on these questions in the subsequent 2-5 years.